

REMARKS

Claims 1-31 were pending in this application. Claims 11, 12, 25 and 30 were withdrawn from consideration as a result of Applicants' response of April 5, 2006. Claims 1-10, 13-24, 26-28 and 31 were rejected in the Office Action dated February 20, 2007. Claim 29 was objected to in the Office Action dated February 20, 2007, but was indicated as allowable if rewritten in independent form.

Claims 1, 10, 21, and 22 are hereby amended merely to more specifically recite inherent aspects of the invention as originally claimed. Claim 29 is hereby amended to an independent claim including the limitations of claim 22. Claims 32-36 are hereby added merely to more specifically define inherent aspects of the invention as originally claimed. No new matter is introduced by the amendments.

Reconsideration of this application as amended, and allowance of all pending elected claims, claims 1-10, 13-24, 26-29, 31, and 32-36, as amended, are hereby respectfully requested.

None of the references teach or suggest annealing the BST thin film without first producing an annealing layer for repairing damage to the BST thin film

Claims 1-8, 9, 10, 13, 14, 15-24, 26-28 and 31 were rejected under 35 U.S.C. § 103(a) as being unpatentable over various combinations of Nakata (Pub. No. 2004/0087082), Olewine et al. (Pub. No. 2003/0067023), Nishioka et al. (U.S. Patent No. 5,489,548), Hartner et al. (U.S. Patent No. 6,503,792), and Moleshi (U.S. Patent No. 5,273,609). This rejection is respectfully traversed.

Independent claim 1, as amended, specifically recites “*after producing the top electrode material, annealing the BST material to repair damage to the BST material without first*

producing an annealing layer in contact with the BST material.” None of the cited references individually teaches this claim limitation and, therefore, no combination of cited references can teach this claim limitation.

In more detail, damage to the BST material is repaired by annealing the BST material without producing any annealing layer that comes in contact with the BST material. During the process of fabricating the capacitor, the BST material may become damaged due to various processes. Therefore, to improve the quality of the dielectric material by repairing the defect, the BST material is annealed. See paragraph [0033] of the specification. This feature is beneficial because the performance of the capacitor can be improved without requiring additional processes to produce and remove the annealing layer.

The support for this added feature can be found, for example, in paragraph [0032] of the specification. In paragraph [0032] of the specification, it is stated that “material for the passivation layer 140 is produced after processing steps for forming the top electrode 130 *but before processing steps for forming any other structure in the capacitor.*” The steps for “forming any other structure” include, among other steps, forming an annealing layer (if the annealing layer is to be formed at all). Because the passivation layer 140 covers any exposed portion of the BST layer 120, paragraph [0032] of the specification indicates that the annealing layer in contact with the BST layer 120 is not produced.

FIGS. 1D, 2E and 3E also support that the annealing layer in contact with the BST layer is not formed. FIGS. 1D, 2E and 3E illustrate capacitors produced according to the embodiments of the present invention. Attention is drawn to the fact that the capacitors of these figures do not show any annealing layer in contact with the BST layer 120. Therefore, paragraph [0032] of the specification and FIGS. 1D, 2E and 3E support the added feature of

“after producing the top electrode material, annealing the BST material to repair damage to the BST material without first producing an annealing layer in contact with the BST material” as recited in claim 1.

This feature of the claimed invention is not shown or suggested by any of the cited references taken alone or in combination. In Nakata, the MIM capacitor is heated in both the first and second embodiment to produce the protective film of silicon nitride that improves the moisture resistance of the MIM capacitor. See Nakata, paragraphs [0026] and [0034]. This heating process is not performed to repair damage to the dielectric layer (silicon nitride). Nowhere in Nakata does it teach or suggest annealing the dielectric layer to repair damage to the dielectric layer.

Likewise, Olewine et al. also fails to teach or suggest this feature of the claimed invention. In Olewine et al., annealing is performed at steps 72 and 76. See Olewine et al., FIG. 5. The annealing processes in Olewine et al., however, are not performed to repair damage to the dielectric layer. To the contrary, the annealing in step 72 is performed to relieve stress in the metal layer (bottom electrode). See Olewine et al., paragraph [0059]. At stage 72 of Olewine et al., the dielectric layer is not yet produced; and therefore, annealing of stage 72 does not repair damage to the dielectric layer. Similarly, the annealing in step 76 also does not repair damage to the dielectric layer. Step 76 of Olewine et al. is performed to reduce the dielectric carbon content and more fully oxidize the dielectric layer. See Olewine et al., paragraph [0062]. Therefore, Olewine et al. does not teach or suggest performing annealing to repair damage to the dielectric layer, as recited in amended claim 1.

Neither does Nishioka teach or suggest this feature. In Nishioka, annealing is performed before depositing the dielectric layer (High-Dielectric-Constant material). See Nishioka, col., 6,

ll. 15-26; and col., 7, ll. 17-29. Therefore, the annealing process does not repair damage to the BST thin film as recited in claim 1, as amended.

Hartner also fails to teach or suggest this feature. In Hartner, in order to perform annealing, a layer (the annealing layer) is applied on the top electrode. See Hartner, col. 8, ll. 16-31. During the heat treatment (annealing) step, the material from the annealing layer is transported to the damaged edges of a dielectric layer. See Hartner, col. 5, ll. 32-42. As Hartner describes, once the annealing layer is produced, removing the annealing layer is difficult and may need additional processes (e.g., heating). See Hartner, col. 5, ll. 16-31. Attention is drawn to the fact that the annealing layer is required to repair the damage in Hartner because $\text{SrBi}_2(\text{Ta,Nb})_2\text{O}_9$ (SBT) (used in Hartner) requires the annealing layer to repair damaged edges. The use of the BST material as recited in the claim conveniently obviates the need to use the annealing layer. Nowhere in Hartner does it teach or suggest that the dielectric material can be repaired “*without first producing an annealing layer*” for repairing the dielectric material as recited in claim 1, as amended.

Neither does Moleshi teach or suggest this feature. Moleshi was cited merely for teaching deposition process in a multi-step processing system. Nowhere in Moleshi does it disclose the feature of “*annealing the BST material to repair damage to the BST material without first producing an annealing layer in contact with the BST material.*”

Nor is there any suggestion or instruction in any of the cited references for combining these disclosures, as the Examiner contends, in any way that would yield Applicants’ invention of claim 1 as amended.

Claims 10 and 22, as amended, also recite the feature of “*after producing the top electrode material, annealing the BST [thin film] material to repair damage to the BST [thin*

film] material without first producing an annealing layer in contact with the BST [thin film] material.” Therefore, essentially the arguments set forth above for claim 1 are equally applicable to claims 10 and 22.

Accordingly, Applicants respectfully submit that claims 1, 10 and 22, and their dependent claims 2-9, 13-21, 23-24, 26-28, and 31, as amended, are patentable for the additional reason that they are patentably distinct from the cited references.

Claim 29 is rewritten in independent form

On page 9 of the Office Action, claim 29 was objected to as being dependent upon a rejected base claim but allowable if rewritten in independent form. Independent claim 29 is hereby amended to include the limitations of claim 22. Therefore, Applicants respectfully submit that claim 29 is now allowable.

Closing

For the reasons given above, Applicants believe that the application is in condition for allowance of all elected claims herein, claims 1-10, 13-24, 26-29, and 31-36, as amended, and therefore an early Notice of Allowance is respectfully requested. If the Examiner believes that for any reason direct contact with Applicants' attorney would help advance the prosecution of this case to finality, the Examiner is invited to telephone the undersigned at the number given below.

Respectfully submitted,

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